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NASA-15186 (March 2003)  
NATIONAL AERONAUTICS NASA  
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SECTION 15186

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SECTION 15186

CONDENSATE PUMPS  
03/03

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NOTE: Delete, revise, or add to the text in this  
section to cover project requirements. Notes are  
for designer information and will not appear in the  
final project specification.

This section covers condensate return pump units and  
condensate steam pumps. Delete, select or rewrite  
any of the following paragraphs as required by  
project conditions.

This specification includes units to indicated  
equivalent direct radiation (edr) with discharge  
pressures of up to 60 pounds per square inch, gage  
450 kilopascal.

Motors are covered in Section 16225, "Motors."

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: The following references should not be  
manually edited except to add new references.  
References not used in the text will automatically  
be deleted from this section of the project  
specification.

\*\*\*\*\*

The publications listed below form a part of this section to the extent  
referenced:

ASME INTERNATIONAL (ASME)

ASME BPVC SEC VIII D1 (1998) Boiler and Pressure Vessel Code;  
Section VIII, Pressure Vessels Division 1  
- Basic Coverage

HYDRAULIC INSTITUTE (HI)

HI SCRRP (1994) Standards for Centrifugal, Rotary  
and Reciprocating Pumps

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1940-1 (1986e) Mechanical Vibration - Balance  
Quality Requirements of Rigid Rotors -  
Part 1: Determination of Permissible  
Residual Unbalance

ISO 2858 (1975) End Suction Centrifugal Pump  
(Rating 16 Bar) Designation Nominal Duty  
Point and Dimensions

ISO 5199 (1986) Technical Specifications for  
Centrifugal Pumps, Class II

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA MG 1 (1998) Motors and Generators

1.2 SUBMITTALS

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**NOTE: Review submittal description (SD) definitions  
in Section 01330, "Submittal Procedures," and edit  
the following list to reflect only the submittals  
required for the project. Submittals should be kept  
to the minimum required for adequate quality  
control. Include a columnar list of appropriate  
products and tests beneath each submittal  
description.**

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The following shall be submitted in accordance with Section 01330,  
"Submittal Procedures," in sufficient detail to show full compliance with  
the specification:

SD-02 Shop Drawings

The following shall be submitted in accordance with paragraph  
entitled, "General Requirements," of this section.

Connection Diagrams  
Control Diagrams  
Fabrication Drawings  
Installation Drawings

SD-03 Product Data

Manufacturer's catalog data shall be submitted for condensate  
pumps showing equipment foundation data and equipment and

performance data including performance curves and indicating brake power, head (gpm) (liter per minute), and NPSH.

#### SD-06 Test Reports

Test reports for condensate pumps shall consist of pump flow capacity tests in accordance with the paragraph entitled, "Testing," of this section.

Pump Flow Capacity Tests  
Efficiency Tests  
Vibration Tests

#### SD-07 Certificates

Listing of product installations for the following items shall include identification of five installed units similar to those proposed for use, that have been in successful service for a minimum period of five years. List shall include purchaser, address of installation, service organization, and date of installation.

Condensate Return Pump Units  
Condensate Receiver  
Reciprocating Steam Pumps

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Condensate Return Pump Units  
Condensate Receiver  
Reciprocating Steam Pumps

### 1.3 GENERAL REQUIREMENTS

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NOTE: If Section 15003, "General Mechanical Provisions," is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted. If Section 15072, "Vibration Isolation for Air Conditioning Equipment," is not included in the project specification, applicable requirements therefrom should be inserted and the second paragraph deleted. If Section 16225, "Motors" is not included in the project specification, applicable requirements therefrom should be inserted and the third paragraph deleted.

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[Section 15003, "General Mechanical Provisions," applies to work specified in this section.]

[Section 15072, "Vibration Isolation for Air Conditioning Equipment," applies to work specified in this section.]

[Section 16225, "Motors" applies to this section.]

Connection Diagrams for condensate pumps shall show details of cable and motor connections.

Control Diagrams shall be submitted for condensate pumps showing motor starters, relays, or any other component necessary for safe operation.

Fabrication Drawings for condensate pumps shall indicate size, type, and efficiency rating.

Installation Drawings for condensate pumps shall be in accordance with the manufacturer's recommended instructions.

Manufacturer's catalog data shall be submitted for condensate pumps showing equipment foundation data and equipment and performance data including performance curves and indicating brake power, head (gpm) (liter per minute), and NPSH.

#### 1.3.1 Factory Tests

The manufacturer shall test the pump and submit prior to shipment of the finished pump the following test data:

Pump Flow Capacity Tests - Pump flow shall conform to requirements listed in accordance with paragraph entitled, "CONDENSATE-RETURN PUMP UNITS," of this section.

Efficiency Tests - Pump efficiency shall conform to the approved design documents.

Vibration Tests - Vibration tests shall conform to requirements listed in accordance with paragraph entitled, "TESTING," of this section.

## PART 2 PRODUCTS

### 2.1 CONDENSATE RETURN PUMP UNITS

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**NOTE:** Revise part title as necessary to include pump number series.

Drawing schedules should indicate data selected from the following to completely define the grimp (grp) low-pressure systems:

Nominal			
Equivalent			
Direct		Approximate	
Radiation	Pump	Gallons	Storage

<u>Square Feet</u>	<u>Capacity GPM</u>	<u>Stored Between Start/Stop</u>	<u>Capacity Gal</u>
1,000	1.5	1.0	10
2,000	3.0	1.5	10
4,000	6.0	4.5	14
6,000	9.0	4.5	14
8,000	12.0	6.5	16
10,000	15.0	7.5	25
15,000	22.5	11.25	30
20,000	30.0	15.0	35
25,000	37.5	18.75	40
30,000	45.0	22.5	45
40,000	60.0	30.0	50
50,000	75.0	37.5	60
75,000	112.5	56.25	80
100,000	150.0	75.0	150

Nominal  
Equivalent

<u>Direct Radiation Square Metre</u>	<u>Pump Capacity Litre Per Minute</u>	<u>Approximate Gallons Stored Between Start/Stop</u>	<u>Storage Capacity Litre</u>
93	5.7	3.79	38
186	11.4	5.68	38
372	22.7	17.03	53
557	34.1	17.03	53
744	45.4	24.61	61
930	56.8	28.39	95
1394	85.2	42.59	114
1858	113.6	56.78	133

2322	141.9	70.98	151
2787	170.3	85.17	170
3716	227.1	113.56	189
4645	283.9	141.95	227
6968	425.8	212.93	303
9300	567.8	283.91	568

Units should be selected to handle a minimum of three times the normal condensate from the system. Normal condensate means, for the purposes of this specification, 1/4 pound per hour per square foot 6 kilogram per square meter per hourequivalent direct radiation (edr) or 0.5 Gallon per minute per 1,000 square feet 2 liter per minute per 100 square meter edr except when small boilers are involved. Discharge pressures and pump revolutions per minute should be indicated.

Receiver capacity should be indicated as nominal.

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NOTE: Pump and Motor balance shall conform to ISO Std. 1940/1 - (1986) Balance Quality Requirements of Rigid Rotors - Determination of Permissible Residual Unbalance unless otherwise noted. Motor vibration levels shall conform to NEMA Specification MG-1, Motors and Generators, Part 7 unless otherwise noted.

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Condensate-return pump units shall be factory assembled and shall include condensate receivers, motor-driven pump(s), manual and automatic liquid-level controls, and other accessories as specified herein or which may be necessary for complete and satisfactorily operating units(s).

Pump(s) and all accessories mounted on the receiver and unit(s) shall be complete with all intercomponent piping and wiring. Receiver and unit(s) shall be complete with all intercomponent piping and wiring. Receiver shall have integral cast lugs for securing to mounting surface. Pump suction piping shall contain a shutoff valve for pump servicing.

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NOTE: When more than one unit is involved, rewrite to include unit identification or indicate on the drawing schedule.

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Condensate-return pump units shall be [simplex] [duplex] type.

Condensate-return pump unit shall be factory tested for capacity and pressure.

#### 2.1.1.1 Pumps

Pumps shall be close coupled or flexible coupled with guard centrifugal volute vertically or horizontally mounted on or next to receiver. Pumps shall conform to applicable requirements of HI SCRRP ISO 2858 and ISO 5199 standards and shall be bronze mounted. Casing shall be close-grained cast iron with renewable wearing ring. Tapped openings shall be provided for automatic venting, draining, and pressure-gage connection. Pump shaft shall be AISI Type 300 series corrosion-resistant steel. Pump seal shall be manufacturer's standard for continuous service at 250 degrees F 121 degrees C, minimum, at seal rotating and stationary members interface and 209-degree F 98 degrees C pumped fluid. Impeller shall be compensated for hydraulic thrust, rotating assembly shall be balanced, and strength of shafting shall be such that when pump is operating at its worst hydraulic condition, vibration readings shall conform to ISO 1940-1, [G6.3] [G2.5] [G1.0][\_\_\_\_\_]. Pumps shall be capable of handling 209-degree F 98 degrees C condensate without cavitation or vapor binding while delivering specified capacity.

#### 2.1.1.2 Motor Requirements

Motors shall be vertical or horizontal and shall conform to NEMA MG 1, requirements specified under the electrical sections of the specifications and to the following additional requirements.

Motor insulation shall be Class H or manufacturer's standard and shall be suitable for satisfactory operation under the following conditions:

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**NOTE: Rewrite following temperatures to suit project.**

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Still air at 65 percent relative humidity, with service-location temperatures to 122 degrees F 50 degrees C

Thermal conduction along motor shaft immersed in 209-degree F 98 degrees C water

Proximity of motor to receiver surfaces at 209 degrees F 98 degrees C

Lubricants shall be specifically suitable for high-temperature service.

#### 2.1.1.3 Receiver

Condensate receiver shall be a single tank constructed of close-grained cast iron with a minimum receiver wall thickness of 5/16 inch 8 millimeter or steel with a rust-resistant interior coating.

Each receiver shall be fitted with:



Redline borosilicate gage glass and nonferrous shutoff valve assembly for use in case of glass breakage

External inlet strainer with removable basket for pump protection

Thermometer with separable well conforming to requirements specified elsewhere in this section

Receiver top-vent connection and drain at lowest point. Drain closures shall be assembled with tetrafluoroethylene tape.

#### 2.1.4 Controls

Simplex-unit control shall consist of a float-operated switch UL rated for the load imposed and wired to the motor. Float and float arm shall be AISI Type 304 or 316 corrosion-resistant steel. Copper float mechanisms are not acceptable.

Duplex-unit control shall consist of a float-operated automatic mechanical alternator controlling at two levels with double-pole alternating switches and operated by a single float. Control shall automatically alternate operation of two pumps to deliver total capacity of two pumps under peak-load conditions, and automatically operate second pump should on-line pump fail. Switch shall be UL rated for the load imposed and shall be wired to motors. Float and float arm shall be AISI Type 304 or 316 corrosion-resistant steel. Copper float mechanisms are not acceptable.

Duplex unit control shall consist of an automatic electric sequence controller used in conjunction with two motor controllers, two selector switches, and two float switches, complete with intercomponent wiring, installed in a NEMA Type 1 enclosure mounted on the receiver. Selector switches shall provide automatic OFF positions. A momentary-contact test pushbutton shall be provided. One float switch shall control the alternator to provide automatic alternation of the two pumps. Second float switch shall provide simultaneous operation of two pumps to deliver total capacity of two pumps under peak-load conditions and automatically operate second pump should on-line pump fail. Switches shall be UL rated for the load imposed. Floats and float arms shall be AISI Type 304 or 316 corrosion-resistant steel. Copper float mechanisms are not acceptable.

#### 2.2 CONDENSATE RECEIVER

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**NOTE: Select for built-up units where crp series capacities are inadequate.**

**Built-up units may utilize reciprocating steam pumps or centrifugal pumps with respective pumping-equipment specifications supplemented to suit project requirements.**

**If an ASME vessel is required, choose the first paragraph; if a manufacturer's standard vessel is sufficient, choose the second paragraph.**

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Receiver shall be designed and constructed in accordance with ASME BPVC SEC VIII D1 for operation under atmospheric conditions but certified as hydrostatically tested at 100 pounds per square inch, gage 690 kilopascal.

Receiver shall be manufacturer's standard vessel.

#### 2.2.1 Materials and Construction

Receiver shall be constructed of either cast iron or galvanized steel [and be a standard item of the manufacturer] with dished heads, indicated openings including those for vent, inlets, discharge, drain, gage-glass connections, and level-control devices. Minimum tank opening shall be 1-inch 25 millimeter iron pipe size. Couplings shall be forged carbon steel. Nozzle-piping weight shall be Schedule 80. Piping, flanges, and fittings shall conform to specifications for connecting condensate piping system.

Receiver shall be mounted as indicated.

One 11- by 15-inch 280 by 380 millimeter gasketed manhole shall be provided at a point in the head or shell for access when receiver is in place.

Receiver internal surfaces, including nozzles, shall be sandblasted to white metal, to a profile required by the coating manufacturer. Internal surfaces shall be coated with a multiple-coat baked or air-dry phenolic system to produce, in not less than three coats, a dry-film thickness of not less than 7 mils 0.175 millimeter. Coating shall be certified as suitable for continuous service when immersed in condensate at a temperature not less than 300 degrees F 149 degrees C.

#### 2.2.2 Accessories

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**NOTE: Supplement following text with specifications for control devices to suit pumps selected.**

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Receiver shall be provided with a shutoff-valve-equipped gage-glass assembly to indicate liquid level over not less than 80 percent of receiver diameter from the bottom. Gage glass shall be red-lined borosilicate glass and shall be fitted with wire or sheet-metal guards.

#### 2.3 RECIPROCATING STEAM PUMPS (RSP)

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**NOTE: Select for remote-location condensate pumping applications, where no electrical power is available. Coordinate with specification of condensate receiver. Weighted or pilot float-operated steam control valve, piped-cylinder end drains, and traps for continuous condensate removal, steam pressure-reducing or speed-governor**

valve as necessary, and discharge line-relief valves.

Show size or capacity on drawings.

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Pump shall be horizontal duplex double-acting reciprocating type.

Pump speed, capacity, materials construction, and installation shall conform to applicable requirements of HI SCRRP ISO 2858 and ISO 5199 Standards, as modified and supplemented herein.

Steam end shall be rated at not less than 250 pounds per square inch (psi) 1725 kilopascal working steam pressure.

Liquid end shall be rated at not less than 125 psi at 212 degrees F 860 kilopascal at 100 degrees C.

#### 2.3.1 Construction

Pump shall be fully bronze-fitted, except that piston rods shall be AISI Type 304 corrosion-resistant steel alumina-ceramic-coated in the packing box area where optionally available.

Steam-end cylinders shall have sufficient thickness to permit up to 1/8-inch 4 millimeter reboring.

Steam end cylinders shall be insulated and sheet-metal lagged.

Liquid end shall be valve-plate type.

Liquid-end cylinder shall be fitted with a replaceable bronze liner.

Cylinder openings shall be manufacturer's standard, flanged whenever optionally available.

#### 2.3.2 Tools and Accessories

One set of special tools shall be provided.

One set of nonmetallic rings and packing for steam- and liquid-end cylinders and one set of steam-end cylinder rings shall be provided.

Pump-actuated mechanical lubricator shall be provided with sufficient lubricant feed points and lubricant storage capacity to permit once-per-week lubrication.

#### 2.3.3 Steam-Cylinder Drainage

All cylinder end drains shall be provided with check valves and Type TOD steam traps.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Equipment shall be installed in accordance with manufacturer's recommendations.

Based on the motor nominal operating speed, the Pump and driver shall be aligned to the following specifications:

Speed(RPM)	angle(mils)	offset(mils/inch)
600	6.0	2.0
900	5.0	1.5
1200	4.0	1.0
1800	3.0	0.5
3600	1.5	0.4
7200	1.0	.03

### 3.2 TESTING

#### 3.2.1 Vibration Analyzer

Contractor shall use an FFT analyzer to measure vibration levels. It shall have the following characteristics: A dynamic range greater than 70 dB; a minimum of 400 line resolution; a frequency response range of 5 Hz-10 KHz(300-600000 cpm); the capacity to perform ensemble averaging, the capability to use a Hanning window; auto-ranging frequency amplitude; a minimum amplitude accuracy over the selected frequency range of plus or minus 20 percent or plus or minus 1.5 dB.

An accelerometer, either stud-mounted or mounted using a rare earth, low mass magnet and sound disk(or finished surface) shall be used with the FFT analyzer to collect data. The mass of the accelerometer and its mounting shall have minimal influence on the frequency response of the system over the selected measurement range.

#### 3.2.2 Acceptance Testing

Prior to pump final acceptance, vibration analysis shall be used to demonstrate that pump and motor are aligned as specified, and any misalignment shall impart no more than .04 inches per second vibration level at 2 times run speed.

Vibration analysis shall also verify pump conformance to specifications. Vibration levels shall not be more than .075 in/sec at 1 times run speed and at pump frequency, and .04 in/sec at other multiples of run speed.

Pump shall be operated and the demonstration shall verify that the pump is nonoverloading at any operating point and that the flow capacity is as specified.

Final test reports shall be provided to the Contracting Officer. Reports

shall have a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --